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Indian Standard

INDUCTOR AND TRANSFORMER CORES FOR TELECOMMUNICATIONS

Sectional Specification : Magnetic Oxide Cores for Inductor Applications

भारतीय मानक

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समूहगत विशिष्टि : प्रेरक अनुप्रयोग के लिए चुम्बकीय आक्साइड कोर

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INDUCTOR AND TRANSFORMER CORES FOR TELECOMMUNICATIONS

Sectional Specification : Magnetic Oxide Cores for Inductor Applications

National Foreword

This Indian Standard, which is identical with IEC Pub 723-2(1983)/QC 250100 'Inductor and transformers core for telecommunications, Part 2 Sectional specification: Magnetic oxide cores for inductor applications', issued by the International Electrotechnical Commission (IEC), was adopted by the Bureau of Indian Standards on 24 November 1988 on the recommendation of the Magnetic Components and Ferrite Materials Sectional Committee (LTDC 13) and approval of the Electronics and Telecommunication Division Council.

This standard is intended primarily for use under the IECQ System. A regular Indian Standard for this component could be different, identical or similar to this standard.

The text of IEC standard has been approved as suitable for publication as Indian Standard without deviations. Certain provisions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

Wherever the words 'International Standard' appear, referring to this standard, they should be read as 'Indian Standard'.

Cross References

In this Indian Standard, the following International Standards are referred to. Read in their respective places the following:

International Standard	*Corresponding Indian Standard*	*Degree of Correspondence*
IEC Pub 205 Calculations of the effective parameters of magnetic piece parts	IS : 7616-1974 Guide for calculation of the effective parameters of magnetic piece parts	Technically equivalent
IEC Pub 226 Dimensions of cross-cores (X-cores) made of ferro-magnetic oxides and associated parts	IS : 7489-1974 Dimensions of cross-cores (X-cores) made of ferro-magnetic oxides and associated parts	Technically equivalent
IEC Pub 723-1 (1982) Inductor and transformer cores for telecommunications : Part 1 Generic specification	IS QC 250000 : 1988/IECQC 250000 : 1982 Inductor and transformer cores for telecommunications : Generic specification	Identical

The Technical Committee responsible for the preparation of this standard has reviewed the provisions of the following IEC Standards and has decided that these are acceptable for use in conjunction with this standard:

IEC Pub 68-1 Basic environmental testing procedures: Part 1 General

IEC Pub 68-2-1 Basic environmental testing procedures: Part 2 Tests — Test A Cold

IEC Pub 68-2-2 Basic environmental testing procedures: Part 2 Tests — Test B Dry heat

IEC Pub 133 Dimensions for pot-cores made of ferromagnetic oxides and associated parts

IEC Pub 367-1 Cores for inductors and transformers for telecommunications: Part 1 Measuring methods

IEC Pub 367-2 Cores for inductors and transformers for telecommunications: Part 2 Guide for the drafting of performance specifications

IEC Pub 367-2A First suplement to Pub 367-2(1974)

IEC Pub 424 Guide to the specification of limits for physical imperfections of parts made from magnetic oxides

IEC Pub 431 Dimensions of square cores (RM-cores) made of magnetic oxides and associated parts

IEC Pub 525 Dimensions of toroids made of magnetic oxides of iron powder

Only the English language text in the International Standard has been retained and French language text has been dropped while adopting it in this Indian Standard.

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SECTION ONE — SCOPE

1. Scope

This sectional specification lists the characteristics, ratings and also the inspection requirements for magnetic oxide cores of assessed quality consisting of at least two parts forming a substantially closed magnetic circuit intended for inductors and tuned transformers for professional and industrial applications. It selects from the generic specification, I E C Publication 723-1, and from the basic specification, I E C Publication 367-1, the appropriate methods of test to be used in detail specifications derived from this specification, in accordance with the corresponding blank detail specification.

The cores covered by this specification may be used with an adjuster to provide a change of inductance for tuning purposes.

SECTION TWO — GENERAL

2. General

2.1 *Related documents*

I E C publications:

Publications Nos. 68-1: Basic Environmental Testing Procedures, Part 1: General and Guidance.
68-2-1: Part 2: Tests — Tests A: Cold.
68-2-2: Part 2: Tests — Tests B: Dry Heat.
133: Dimensions for Pot-cores Made of Ferromagnetic Oxides and Associated Parts.
205: Calculation of the Effective Parameters of Magnetic Piece Parts.
226: Dimensions of Cross Cores (X-cores) Made of Ferromagnetic Oxides and Associated Parts.
367-1: Cores for Inductors and Transformers for Telecommunications, Part 1: Measuring Methods.
367-2: Part 2: Guides for the Drafting of Performance Specifications.

424: Guide to the Specification of Limits for Physical Imperfections of Parts Made from Magnetic Oxides.
431: Dimensions of Square Cores (RM-cores) Made of Magnetic Oxides and Associated Parts.
525: Dimensions of Toroids Made of Magnetic Oxides or Iron Powder.
723-1: Inductor and Transformer Cores for Telecommunications, Part 1: Generic Specification.

2.2 *Classification*

A core is classified by:

a) shape: for example Pot-core, X-core, RM-core, ...,

b) size: for example 18 × 11, X 22, RM 6, ...,

c) class (combined electromagnetic properties, for example temperature coefficient and losses at given frequencies) or material grade.

Since no systematic classification of the electromagnetic properties is available in the I E C, each detail specification shall clearly define the class to which it applies. It may also state the appropriate class designation.

Normally, a detail specification will cover cores of one shape, size and class.

SECTION THREE — QUALITY ASSESSMENT PROCEDURES

3. Quality assessment procedures

3.1 *Formation of inspection lots and test methods*

3.1.1 The tests shall be selected from those given in Section Four of I E C Publication 723-1 or, failing that, shall be described in the detail specification.

3.1.2 Visual examination and measurement of dimensions may be carried out either on half-cores prior to pairing or on sets (see note). The disaccommodation may be measured either on toroidally wound half-cores, if they have a central hole, or on sets (ungapped or gapped). All other tests shall be carried out on sets (see also Sub-clause 3.4).

The temperature coefficient shall be measured on gapped sets. Wherever possible, the permeability temperature factor shall be measured on ungapped sets.

Note: — A set is a pair of half-cores.

3.1.3 The mechanical tests for the adjusting device are only applicable when the cores are supplied with the fixed part of the adjusting device attached.

3.1.4 The test coils for inductance, and those for loss tangent or *Q*-factor measurement shall be fully defined; this may be fulfilled by reference to a national or international standard (see, for example, I E C Publication 431 for standard inductance measuring coils for RM-cores).

3.1.5 For cores consisting of more than one part, the clamping force in accordance with Clause 4 of I E C Publication 367-1 shall be stated on the understanding that, when the manufacturer specifies a deviating clamping force, the latter shall be used. If required, details of the application of the force shall be given (see, for example, Appendix 1 to I E C Publication 367-2).

3.1.6 The number of specimens of each inductance factor in the sample shall be approximately proportional to the numbers in the inspection lot and no value shall be systematically excluded from testing.

3.2 *Inspection for qualification approval*

3.2.1 When it is desired to obtain qualification approval by adopting the fixed sample size procedure (see Clause 8 of I E C Publication723-1) use shall be made of the test schedule given in Sub-clause 3.3 of this specification. The details of the tests are as specified in the quality conformance test schedule (see Sub-clause 3.4). When the blank detail specification contains tests not included in the fixed sample schedule of Sub-clause 3.3, these shall be added either in the appropriate group or in one or more additional groups, and the total number of specimens (Group 0) shall be adjusted accordingly.

3.2.2 When the detail specification covers more than one inductance factor, the sample for qualification approval shall include approximately equal quantities of the highest value, the lowest value and a value near the middle of the range for which approval is sought. As a general guide, the sample for each group (1, 2, etc.) for qualification approval shall be equivalent to the corresponding group of the quality conformance test schedule and shall allow acceptance when one defective occurs in the sample. The sample size for group 0 shall be the sum of the sample sizes of the other groups plus two specimens to replace one possible defective in group 0 and one due to mishandling.

There is at present no agreed procedure for the qualification approval of cores including an adjusting device.

3.3 *Fixed sample size qualification approval test schedule*

The following sample size shall be used for carrying out qualification approval tests.

For test conditions and other details see Sub-clause 3.4 of this specification and Table I of the appropriate blank detail specification (as in I E C Publication 723-2-1: Inductor and Transformer Cores for Telecommunications, Part 2: Blank Detail Specification: Magnetic Oxide Cores for Inductor Applications. Assessment Level A).

1) *Cores without adjusting device*

Group 0: 41 specimens (1 defective allowed)

12.1 Visual examination
12.2 Marking
12.3 Primary dimensions
13.3 Inductance factor
13.7 Residual and eddy current loss

Group 1: 13 specimens (1 defective allowed)

12.4 Secondary dimensions
13.8 Hysteresis loss
14.1 Compressive strength

Group 2: 13 specimens (1 defective allowed)

13.5 Variation of permeability with temperature

Group 3: 13 specimens (1 defective allowed)

13.4 Disaccommodation
14.2.1 Expulsion force (when applicable)

2) *Cores with adjusting device*

There is at present no agreed schedule for these components.

3.4 *Quality conformance inspection*

The following characteristics shall be included as a minimum in all blank detail specifications and for all assessment levels:

3.4.1 *Physical*

a) Visual examination.

b) Marking.

c) Dimensions (primary and secondary).

Note. — Primary dimensions are the dimensions controlled by the gauge(s) defined in the appropriate IEC publication, for example, for pot-cores: IEC Publication 133.
Secondary dimensions are all those dimensions shown in the appropriate IEC publication but not controlled by the gauge(s).

3.4.2 *Electrical*

a) Inductance factor (in nanohenrys [nH]) with tolerance (as a percentage).

b) Losses at low flux density:

— Residual plus eddy current loss at one or more frequencies depending upon the extent of the frequency range of the application. This may be given in terms of:

for ungapped sets: loss factor $\frac{\tan \delta_{r+F}}{\mu_i}$
for gapped sets: tangent of loss angle $\tan \delta_{r+F}$ or, where correction for coil loss would result in unacceptable error, quality factor Q_{r+F}

— Hysteresis loss at one frequency. This may be given in terms of:
for ungapped sets: hysteresis material constant η_B
for gapped and ungapped sets: tangent of loss angle $\tan \delta_h$

c) Variation of permeability with temperature. This may be given in terms of:

for gapped and ungapped sets: temperature factor α_F
for gapped sets: temperature coefficient α_L

d) Disaccommodation factor D_F.

Note. — It is preferable for this measurement to be made on ungapped sets or on single cores.

3.4.3 *Mechanical*

a) Compressive strength.

b) Expulsion force (when applicable, see Sub-clause 3.1.3).

SECTION FOUR — ADDITIONAL INFORMATION

4. **Additional information**

Additional information, for example on application, in the form of curves, graphs, typical values, etc., may be included or separately given by the manufacturers. This is supplied for information only and shall not be used for inspection purposes.

SECTION FIVE — BLANK DETAIL SPECIFICATION

5. **Blank detail specification**

The following information and requirements shall be included in each detail specification, together with the required values:

5.1 *Identification of the specification*

The identification of the detail specification shall include:

a) the name of the national standards organization under whose authority the detail specification is issued;

b) the number of the IEC blank detail specification used;

c) the number and issue status of the national generic specification;

d) the national number of the detail specification, date of issue and any other information required by the national system.

5.2 *Identification of the core*

The identification of the core shall include:

a) shape and size of the core, for example pot-core 18 × 11;

b) a short description of the class or material grade, for example "high permeability";

c) an outline drawing and dimensions, stating the dimensions in millimetres and indicating which are the primary dimensions. When the dimensions are in accordance with those published in an IEC standard, this shall be stated. Primary dimensions are those checked by stated gauges, for example as defined in that IEC standard;

d) the application or group of applications, and an indication of the quality assessment level;

e) reference data giving information on the most important properties of the core, which allow comparison between the various core types intended for the same or for similar applications. These include, but are not limited to:

- effective parameters (see Clause 5 of IEC Publication 723-1);
- operating conditions (see Sub-clause 5.3.1);
- storage conditions (see Sub-clause 5.3.2).

5.3 *Limiting conditions (not for inspection purposes)*

5.3.1 *Operating conditions*

Any mechanical, environmental or electrical conditions which may cause damage to the core or which may cause certain parameters to exceed the specified limits, shall be stated, for example:

- temperature range within which the specified temperature factor or coefficient is valid (see Sub-clause 3.4.2, Item *c)*), for example +5 °C to +55 °C;
- typical operating frequency range of the material, for example up to 300 kHz.

Note. — For standard temperatures, see IEC Publications 68-2-1 and 68-2-2.

5.3.2 *Storage conditions*

The environmental conditions shall be stated for ferrite cores only and, when applicable, also for ferrite cores with auxiliary devices, for example:

- ferrite core only: −55 °C to +100 °C;
- ferrite core with auxiliary devices: −10 °C to +55 °C, but a combination of high humidity and high temperature shall be avoided.

5.4 *Marking*

5.4.1 *Core set*

The following shall be marked as a minimum on each core or on one-half of a set of cores:

- class or grade of material (may be in coded form).

Where space permits, the following shall also be marked on each core:

- manufacturer's trade mark;
- inductance factor (may be the numerical value in nanohenrys without the indication of that unit, for example 100);
- lot identification (may be day of release).

When writing the detail specification, it shall be decided what marking shall be included on the core.

5.4.2 *Core package*

The following shall be marked as a minimum on the core package, in the order given:

a) detail specification reference number;
b) manufacturer's name or trade mark;
c) manufacturer's component designation;
d) inductance factor in nanohenrys;
e) lot identification;
f) quantity.

Any additional marking shall be so applied that no confusion can arise.

5.5 *Ordering information*

The detail specification shall indicate that the following information is required when ordering cores:

a) detail specification reference number;

b) manufacturer's component designation;

c) inductance factor in nanohenrys;

d) quantity required;

e) further information required by the manufacturer to identify the product.

5.6 *Related documents*

I E C Publication 723-2 (this sectional specification) or its national equivalent, together with any other publication needed to implement the detail specification, if not included in the above, for example the number with issue status and date and the title of a (national or international) dimensional standard for the core and/or test coils.

5.7 *Additional specifications or test details*

Where it is inconvenient to provide details in the test inspection schedule, the requisite information should be given separately. If an appendix is used for this purpose, it shall be suitably referenced.

5.8 *Certified test records (CTRs)*

Whether required or not. When required the CTR shall comply with Clause 11 of I E C Publication 723-1.